6.III-3 GENERAL REQUIREMENTS FARE TRANSACTION PROCESSOR (FTP)

The requirements stated in this Section shall apply to all configurations of fare transaction processors supplied under this Contract as described in Section 6.III-4, 6.III-8 and 6.III-9; but also, as applicable, to the related modules described in Section 6.III-5 through 6.III-7.

6.III-3.1 Subsystem Description - FTP

The FTP is the region's fare collection device for the RFCS. The basic functionality of all FTPs is essentially the same, only the physical packaging is customized for the environment in which it will be used. In addition to collecting fares and validating passes, the FTP shall:

(a) Store transaction history

(b) Check for blocked cards

(c) Perform automated revalue

(d) Dump all transaction data to the Wireless Data On/Off Loading System, if directly connected, when a data transfer is initiated.

(e) Send each transaction , as it occurs, to the Vehicle Logic Unit, if available

3.1.1 FTP Configurations

The Contractor shall provide the following FTP configurations that will read the data on the fare card, process the corresponding transaction, write the correct data back to the fare card, and transfer the transaction records to the appropriate data acquisition computer (DAC) or direct to the clearinghouse system:

(a) On-Board FTP – will be used by all Agencies except WSF to process fare transactions aboard buses (Section 6.III-4.)

(b) Portable FTP – are small, hand held devices used primarily in the WSF environment to process fare transactions where fixed equipment is impractical or unnecessary (Section 6.III-8.)

(c) Stand-Alone FTP – are also used primarily in the Sound Transit and WSF environments in locations where a fixed, stationary device is appropriate. Rail Platforms and Ferry Docks will have multiple stand-alone FTPs which will enable passengers to tag the FTP associated with their destination (Section 6.III-9.)

3.1.2 FTP Configuration Requirements

All FTP configurations shall include the following elements that are described in the subsequent Subsections:

(a) Central Processing Unit

(b) Memory

(c) Smart Card Interface

(d) Customer Interface

(e) Hardware Interface

6.III-3.2 Functional Requirements - FTP

The following general FTP functional requirements apply to all configurations of FTPs.

3.2.0 Central Processing Unit

The FTP central processing unit shall be capable of supporting, at a minimum, the following functions:

(a) Prior to use for fare collection or customer service, the FTP shall initialize itself and accept log-on from Agency Personnel. Method of log-on depends upon FTP configuration and is addressed in the functional requirements sections of each configuration.

(b) Upon reading a card for fare payment, the FTP shall:

i. Indicate if the card is valid. A blocked or improper card shall trigger a red light on the customer display and an audible warning.

ii. Indicate whether or not the Cardholder has the proper fare, pass, or transfer on their card for the ride they are taking.

iii. Make the appropriate deduction, considering any discounts applicable, and update any appropriate trip counting data fields.

iv. Display the remaining value on the card and display an indication of special fare or pass type, if used, and any frequency discount which has accrued.

(c) The FTP shall store and process the transaction data for upload to the DAC.

(d) Using displays, light indicators, and audio tones, the FTP shall provide operator and customer feedback for each transaction.

(e) The FTP shall maintain collected transaction data in the event of a device, interface, or power failure.

(f) The Contractor shall provide a method to ensure the integrity of the data on the OBFTP until a successful data exchange with the WDOLS is acknowledged.

3.2.1 Memory Requirements

3.2.1.1 Capacity

(a) The Ftp shall use solid state memory with sufficient capacity to store at a minimum, all data subsequent to the last data upload to the DACS including:

i. Up to 10,000 transaction records.

ii. 100 log-in / log-off records.

iii. 100 Event records such as, but not limited to FTP malfunctions, failed read attempts, successful and unsuccessful data up- and down-loads.

iv. 6,000 bad card numbers for cards issued to the general public.

v. Card block or status change information for all campus cards in circulation (capacity is required to update the status of all campus cards at an academic quarter or semester change).

vi. Secret keys for communication and card access.

vii. Manager passwords.

viii. Fare tables.

ix. Automatic card revalue information.

x. Vehicle identification number or designated location code to be programmed at time of installation.

xi. Any Agency specific data required.

(b) As transaction volumes increase, FTP memory shall be expandable to a capacity of at least five times that for previously listed items i. through xi.

(c) The Contractor shall provide data storage for the OBFTP which uses non-volatile memory.

3.2.1.2 Captured Ride Data

Ride data is captured in the FTP when cards are tagged by customers. The data is recorded in groups, called intervals. Using the data fields identified below and additional fields if necessary, the FTP shall capture and/or generate the following data. In addition to this, the FTP shall also capture and/or generate the data required for the WSF POS System as described in Appendix E-6.

(a) Transaction Header Data (for each recording interval)

Each interval shares common header data, which applies to each transaction in the group. An interval may represent one direction of a route (e.g., inbound or outbound or ferry route destination), an individual vehicle stop, or it may represent a period of time at a fixed location. An example of the possible transaction header data is subsequently shown.

Data Field	Comments
Agency or Subcontractor providing ride	
Transaction Location 1	Station or Ferry Terminal
Transaction Location 2	Route or Vehicle Stop
Direction	Direction of ride (inbound or outbound) or Run Number
Ride date	
Time of Interval Start	

(b) Transaction Detail (for each captured ride transaction)

The first part of transaction detail (current ride) reconciles rides and provides settlement data and ride statistics. The last ride data (read from card) validates transfer pricing and supports transaction reconciliation at the clearinghouse database. An example of the possible transaction detail is subsequently shown.

Data Field	Comments
Driver/Seller/Attendant Log-on	
FTP Number	
Time of Tag	
FTP Transaction ID	Transaction sequence number generated by FTP
Card Serial Number	
Transaction Code	Ride, Reversal, Adjustment, Transfer
Amount of Transaction	If fare is decremented
Remaining Value on Card	Current stored value or stored rides written back to card, depending on process code

The following set of data fields shall be provided but requires fare policy decision for activation.

Data Field	Comments
Transaction Code	
Terminal Exit Tag	
Time of Exit	
Exit Transaction Location	

It is anticipated that the following data from the Ride History (Section 2.4.3.6) on the card are required for the recovery of missing transactions.

Data Field	Comments
Last Agency Providing Service	
Location of Last Transaction	
Date of Last Transaction	
Time of Last Transaction	
Transaction Code	Ride, Reversal, Adjustment, Transfer, or Cash fare

3.2.2 Smart Card Interface

The FTP contactless interface shall meet ISO 14443, parts 2, 3, and 4. While this proposed standard has not yet been fully ratified as an accepted standard, fare cards shall be in conformance with its most recent release at the time of proposal submittal .

(a) Power and Signal Interface Standards — The Contractor shall conform to the standards for contactless cards specified in the most recent release of ISO 14443-2.

(b) Initialization and Anti-Collision Protocol

i. The card and FTP shall accommodate an anti-collision protocol preventing erroneous processing when more than one card is simultaneously brought within the processing range of the FTP.

ii. The initialization and anti-collision protocols shall conform to the specifications of ISO 14443-3 as they develop.

iii. In the absence of such a protocol, the Contractor shall propose a standard subject to Project Manager approval.

iv. **Optional:** Through operator intervention, such as holding down a designated button, an FTP shall be able to process a stack of up to five (5) fare cards. This feature is of interest to Washington State Ferries for Stage 2 implementation to support vehicle-level operations where multiple cards may

be presented simultaneously. This manual override of the anti-collision protocol shall be subject to the review and approval of the Project Manager.

(c) Transaction Protocol

i. The fare card transaction protocol of those transactions that will be performed through the contactless interface, shall conform to the specifications of ISO 14443-4 as they develop.

ii. In the absence of such a protocol, the Contractor will propose a standard subject to Project Manager approval.

(d) Operating Range

i. The card and FTP shall interface within the distances and relative orientations defined in ISO 14443.

ii. RFCS equipment read-write distance shall be adjustable from zero to the maximum defined in ISO 14443.

iii. The distance shall be optimized once the system is in operation.

3.2.3 Customer Interface

The Contractor shall provide a customer display to provide the customer with transaction status information as follows:

(a) Message indicating the FTP is not operational “OUT OF SERVICE”.

(b) The Project Manager will define the message sets and formats with the Contractor during the design review process.

(c) The message sets shall be finalized after the Beta Test program has been completed.

(d) Display messages shall be easily edited on an as needed basis, once the system is in operation.

(e) At a minimum, the following messages shall be provided:

i. Default or idle message to indicate the system is operational such as, “READY.”

ii. Fare type and amount deducted.

iii. Remaining value on the card. Activation of this feature for Full System Rollout shall be finalized after completion of the Beta Test program.

iv. Indication of an unsuccessful transaction with reason such as, “Invalid read/encode – try again,” “Insufficient value,” “Invalid card – Call Service Center.”

v. Indicator that the card has a low remaining value such as “low value.”

vi. Message sets customized according to inter-Agency transfer agreements and fare policy.

(f) The display menu and display messages shall be programmable using a developer’s utility, supplied by the Contractor, running on a Windows-Intel PC with the capability to upload the modified menu or messages to the FTP using a standard PC port.

(g) The messages and displays shall also be modifiable from a central location.

3.2.3.1 Light Indicator

(a) The FTP shall be equipped with transaction status indicators visible to the customer.

(b) These indicators shall consist of a “Green-, Yellow-, and Red-Light” to indicate a successful or unsuccessful transaction.

(c) This feature augments the alpha numeric display. Figure III-3.1 summarizes customer visual indicators.

3.2.3.2 Audio Indicator

(a) An audio feedback for indicating the completion of a successful or unsuccessful transaction shall be also be provided.

(b) The audio indicators shall be different sounds or different volume levels of the same sound.

(c) The FTP sound level shall be controlled with a minimum number of keystrokes or adjustments by the operator of the relevant FTP.

(d) The type of audio feedback and the parameters are subject to Project Manager approval. Figure III-3.1 summarizes customer audio indicators.

Figure III-3.1
CUSTOMER INDICATOR MATRIX

Condition	Visual Indicator	Audio Indicator
Successful Transaction	Green	Indicator 1

Warning - i.e. low card value	Yellow	Indicator 2
Incomplete or failed read	Yellow Flashing	Indicator 3
Unsuccessful Transaction - i.e. insufficient value, expired pass, blocked card	Red	Indicator 4

3.2.4 Hardware Interface

(a) The FTPs shall be equipped, at a minimum, with the following two communications ports:High-Speed Serial Communications Port (for connection to WDOLS in the absence of the VLU);

(b) RS232 Communications Port (for troubleshooting and as a back-up data download/upload interface).

6.III-3.3 Performance Requirements

3.3.1 Processing Time

The processing of a transaction shall be completed within 0.3 seconds (300 ms). The following shall be concluded within this time frame:

(a) Initialization

(b) Authentication and other security processes

(c) Data Exchange (read and encode)

(d) Computation of fare, including applicable incentives or discounts

(e) Display of results on the customer (and any other applicable) displays

3.3.2 Accuracy and Reliability

(a) Accuracy for all types of FTPs is defined as the mean ratio of the number of transactions correctly recorded by the FTP, as evidenced by the transactional data recorded and stored on the fare card, to the number of transactions attempted.

(b) As part of Factory Acceptance Testing (Section 6.II-11.4.2) and Acceptance Testing (Section 6.II-11.4.7), the Contractor shall demonstrate a minimum FTP transaction processing accuracy rate of 99.99% as identified in Item (a) above.

(c) The FTP reliability shall be a minimum of 120,000 mean transactions between failures (MTBF) for a high transaction

volume environment and 7,500 Mean Operating Hours Between Failures (MOHBF) in a low transaction volume environment.

(d) Any single FTP that fails more than two (2) times per month (Type II failures - see 6.II-11.4.8.7) shall be replaced with a new unit. If the new unit experiences the same failure rate, the Contractor shall be responsible to initiate an investigation to determine why the unit fails, and then shall perform repairs, or redesign the unit as necessary and replace the existing units with the redesigned units.

(e) FTPs shall average no more than two Type II (see 6.II-11.4.8.7) failures per FTP configuration type every 90 days for the total population for each type of FTP in revenue service. This is in addition to MTBF requirements because of population size of FTPs.

6.III-3.4 Physical Requirements

3.4.1 Appearance and Styling

(a) Each type of FTP shall conform to generally accepted practices in appearance and styling, within the limitations of materials used for construction, and shall be approved by the Project Manager at the Preliminary Design Review. (DR 37)

(b) All exterior surfaces shall be clean with all corners rounded.

(c) There shall be no exposed bolt heads, nuts, sharp edges, or cracks on the outside surfaces.

(d) All displays shall be flush mounted in the enclosures.

3.4.2 Structural Features

(a) The finish shall be orbital finished stainless steel, unless specified otherwise or approved by the Project Manager.

(b) Provisions shall be incorporated to drain any liquids that may enter the device or condensation that may develop.

3.4.3 Customer Display

(a) The display shall be water and liquid resistant.

(b) Any leakage into the unit shall not cause the unit to become non-operational.

(c) The display technology shall be subject to Project Manager approval and shall meet the following requirements:

i. Readable under any combination of ambient lighting such as direct sunlight and night-time operation;

ii. At least two lines of alpha-numeric text with a minimum of twenty characters readable from 6 feet.

(d) The display shall resist breakage due to accidental impact from hard objects, such as briefcases, during boarding, wheelchair handles or other devices used by the disabled community.

(e) Stage 2 for WSF will require two customer displays at vehicle toll booths. Both displays shall show the same messages simultaneously.

3.4.4 Locks and Security

(a) Access cover(s) of the FTP housing shall be opened with mechanical key(s) for maintenance access to the modules and subassemblies.

(b) The key(s) shall be of a type that is not readily duplicated and stamped with the words “Do Not Duplicate”.

(c) Alternative means of securing the internal components shall be subject to Project Manager approval.

3.4.5 Identification Labels

(a) A metal identification label inscribed with the FTP serial number shall be permanently attached to the outside of each FTP housing.

(b) Major subassemblies inside the FTP shall have a permanently attached label inscribed with a unique serial number and part number prominently located on the subassembly.

3.4.6 Modularity

(a) The FTP shall be packaged as a separate unit and not bundled with the DDU or WDOLS.

(b) The FTP shall use connectors, approved by the Association, for all external connections.

6.III-3.5 Environmental Requirements

The FTPs and related modules shall be designed to comply with all applicable FCC regulations concerning conducted and radiated emissions of RF energy and shall operate in the environmental conditions provided in Figure III-3.2.

Figure III-3.2
FTP OPERATING ENVIRONMENT

Parameter	Minimum Requirement
Temperature Range:	+10°F to +110°F operating; -25°F to +150°F storage
Thermal Shock:	Per SAE J1455 (Jan 88) Section 4.1.3.2
Thermal Cycle:	Per SAE J1455 (Jan 88) Section 4.1.3.1
Humidity:	20% - 90% relative humidity, non-condensing
Shock:	Up to 5g instantaneous and horizontal
Vibration:	1.5g (RMS), 5 to 200 Hz
EMI Susceptibility: *Example sources: Heater and air conditioning controls, high voltage arcs, alternators, radar and radio from WSF operations, etc.*	Conducted MIL-STD-461B, Requirement CS06, utilizing the 400 volt, 5 microsecond pulse, both positive and negative polarity. Radiated SAMA Standard PMC 33.1.1978 (*or approved alternative*), Class 2 (10 volts per meter), frequency bands a, b, & c, including paragraphs 5.3.3 (Digital Equipment Modulation Test) and 5.3.4 (Keying Test).
Other (dust, grit, rain- and salt water protection) :	Airborne particles and dust encountered in the bus operating environment, and caused by general cleaning and sweeping Rain, clean to dusty with blown grit and sand, outdoor marine environment, airborne particles, dust and automobile exhaust combined with marine air as encountered in the WSF environment

6.III-3.6 Data Exchange Requirements

All software and fare table upgrades shall be loadable through a PC industry standard communications port.

The FTP clock shall be synchronized via the LonWorks port, if available on LonWorks, or with the DACS clock if not available on LonWorks. If the DACS clock is used, synchronization shall occur during data on and off loads.

3.6.1 Communication Ports

The Contractor shall provide a Communications Interface Specification (CDRL 32) for the FTP. At a minimum, this specification shall include a description of the data elements and communication protocols for the following required ports:

(a) High-Speed Serial Communications Port (for connection to WDOLS in the absence of the VLU);

(b) RS232 Communications Port (for troubleshooting and as a back-up data download/upload interface).

The Communications Interface Specification shall also describe the data elements and communications protocols for additional communication ports required by the specific FTP configurations: see Sections 6.III-4, 6.III-8, and 6.III-9.

3.6.2 FTP Back-Up System

(a) The Contractor shall provide an alternate means of extracting data from the FTP, such as via a laptop computer, subject to Project Manager review and approval.

(b) The backup system shall be used primarily to upload captured transaction data from the FTP.

(c) It shall be possible to manually upload/download data files in the event of a device or interface failure through an RS 232 port.

(d) In the event of a primary data storage failure or backup battery failure, an indication on the display shall alert the operator.

(e) Correct password entry shall automatically enable the FTP to download the transaction data to the back-up device.

i. Neither the FTP nor the backup device shall retain the correct password.

ii. Unsuccessful attempts to enter the password shall be logged at the FTP.

iii. The log shall contain detailed information including, the date, time, location, FTP number, and erroneous password.

(f) An alternate process for initiating data extraction may be provided which shall be subject to Project Manager review and approval.

(g) Alternate means of removing data records may be provided.

i. The Contractor shall provide a detailed description and the technical details necessary for Project Manager evaluation.

ii. Alternative means of data removal are subject to Project Manager approval.

(f) If the FTP is removed for depot maintenance, the backup method shall upload captured transaction data to a depot DAC or to the clearinghouse.

6.III-3.7 Testing Requirements and Procedures - FTP

In addition to testing specified in Section 6.II-11.4 "Testing Requirements" the following tests shall be performed.

3.7.1 Cycling Test

Cycling test for each type of FTP shall be performed as follows on the first unit representative of the production units.

(a) A minimum of 10,000 transactions, and at least 500 data downloads and 200 fare table up-loads shall be conducted.

(b) Transactions shall be divided evenly among all possible fare deduction and Agency transfer transactions of which the device is capable.

(c) The fare amounts shall be representative of those expected to be employed in the RFCS. Detailed information regarding the transaction types and values to be used in the cycling test shall be included in the Detailed Test Procedures and subject to Project Manager approval.

3.7.2 Vibration Test

The Contractor shall ensure that all vehicle fleet vibration conditions expected in the area of equipment installation are taken into account to ensure that proper isolation/protection is built in to the design of equipment that may be used in an on-board environment to accommodate the range of frequencies anticipated for the vehicle fleet. The following requirements shall be met.

(a) The FTP components shall be tested per the procedure of *MIL-STD-810C, Method 514.2, Category f, Curve V (1.5g, 5.5 to 200 Hz)* with the following changes:

– The cycling time shall be two (2) hours on each axis for a total of six (6) hours. The equipment shall operate normally

during and after this acceleration test, and shall not experience broken or loosened parts from this vibration.

– At the conclusion of each axis frequency sweep cycle, the equipment shall be subjected to a vibration of three (3) g-forces at a frequency sweep between seven (7) and fourteen (14) Hz for a period of one (1) minute and four (4) g-forces at a frequency sweep between seventy (70) and one hundred and forty (140) Hz for a period of one (1) minute. The equipment shall operate normally after these acceleration tests and shall not experience broken or loosened parts from this vibration.

3.7.3 Shock Test

The FTP equipment shall be tested per *Procedure I of MIL-STD-810C* with the following changes:

(a) The half sine shock pulse shall have a peak value (A) of 5g and a duration (D) of 20 milliseconds.

(b) The on-board equipment shall operate normally after the shock tests and shall not have experienced broken or loosened components as a consequence of these tests.

6.III-3.8 Additional Security Requirements - FTP

The Contractor shall provide a means to prevent unauthorized tampering with a stolen or lost FTP and Related Modules.

(a) The Contractor shall design the FTP to prevent unauthorized recovery of electronic value stored in the memory, or “reverse engineering” which would compromise the RFCS system security.

(b) Back-up power source shall be provided in case of primary battery failure that provides at least 15 minutes of additional power and allow the FTP to securely power down and retain all data.

(c) Each type of FTP shall be provided with a non-volatile memory for storage of the data files for at least 72 hours as described in the Data Backup Plan (CDRL 7).

6.III-4 ON-BOARD FARE TRANSACTION PROCESSOR (OBFTP)

6.III-4.1 Subsystem Description - OBFTP

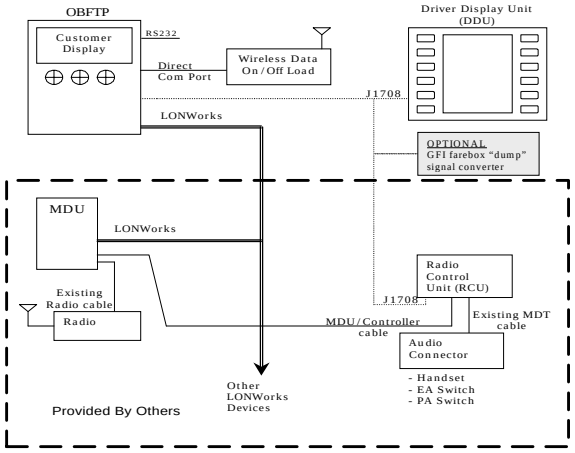
The Contractor shall provide On-Board Fare Transaction Processors (OBFTP) allowing fare cards to be read and encoded through the contactless interface during the fare payment process on-board Agency buses. The OBFTP shall consist of a CPU for processing transactions, memory for storing fare tables and transaction records, customer display, and card reader.

The OBFTP shall be capable of operating, when delivered, in a limited integration mode or as a plug-n-play peripheral (full integration mode) on an on-board network to be provided by others. Initially, the Association expects to operate the OBFTPs with a limited degree of integration, and then migrate to a full integration mode when an on-board Vehicle Logic Unit (VLU) is developed and installed by others (see Section 6.III-5). The architecture of the OBFTP shall allow each agency to migrate from the limited integration mode to the full integration mode at any time in the future. The OBFTPs, when delivered, shall be capable of supporting the following two modes of operation.

4.1.1 Limited Integration Mode (LIM)

In the Limited Integration Mode, the OBFTP shall store transactions until communication with the WDOLS is established and data transfer can be completed. The OBFTP shall connect to the Driver Display Unit (DDU) via SAE J1708 and to the Wireless On/Off Loading System (WDOLS) via a standard high-speed serial communications port. As an individual agency option, the limited integration mode shall provide GFI farebox keypad emulation in the DDU, and shall support communication of the farebox "dump" signal from the DDU to the farebox. See Figure III-4.1.

Figure III-4.1
OBFTP ARCHITECTURE for LIM



4.1.2 Full Integration Mode (FIM)

In the Full Integration Mode, when the VLU is available, the OBFTP shall send transactions as they occur to the VLU (provided by others) for subsequent offloading to the WDOLS. The OBFTP shall connect to the WDOLS via the VLU using LonWorks ports; while the DDU shall connect to the VLU through a J1708 port. Communication between the OBFTP and the DDU/WDOLS shall be through the VLU using the networks described. The VLU will be provided by others. See Figure III-4.2.

Figure III-4.2
OBFTP ARCHITECTURE for FIM

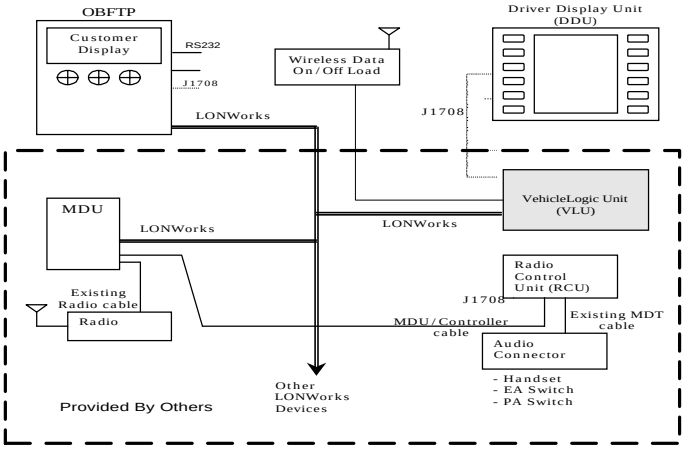


Figure III-4.3 identifies the module interfaces that apply to the Limited Integration Mode (LIM). The Contractor may suggest alternative on-board configurations in addition to the configuration provided, subject to the review and approval of the Project Manager.

Figure III-4.3
MODULE INTERFACE SUMMARY - LIM

Modules	OBFTP	DDU	WDOLS	VLU	GFI Farebox
OBFTP		J1708	High-Speed Serial Communications	N/A	Contractor Defined
DDU			N/A	N/A	N/A
WDOLS				N/A	N/A
VLU					N/A
GFI Farebox					
Note: The actual number of communication ports for the OBFTP is four (see Section 6.III-4.2), although some may not be used for this mode of operation.					

Figure III-4.4 identifies the module interfaces that apply to the Limited Integration Mode (LIM). The Contractor may suggest alternative on-board configurations in addition to the configuration provided, subject to the review and approval of the Project Manager.

Figure III-4.4
MODULE INTERFACE SUMMARY – FIM

Modules	OBFTP	DDU	WDOLS	VLU	GFI Farebox
OBFTP		N/A	N/A	LonWorks	N/A
DDU			N/A	J1708	N/A
WDOLS				High-Speed Serial Communications	N/A
VLU					LonWorks
GFI Farebox					
Note: The actual number of communication ports for the OBFTP is four (see Section 6.III-4.2), although some may not be used for this mode of operation.					

6.III-4.2 Functional Requirements - OBFTP

(a) The following functional requirements supplement those stated in Section 6.III-3.2. The OBFTP shall accept driver input through the drivers display unit (DDU) for security, data collection and operational purposes.

(b) The OBFTP shall transfer data to and from the DAC via a wireless off/on loading system, Section 6.III-7.

(c) The OBFTP shall have a minimum of four (4) communications ports:

i. High-Speed Serial Communications Port (see Section 6.III-3.2.4);.

ii. RS232 Communications Port (see Section 6.III-3.2.4);

iii. SAE J1708 Communications Port (for connection to the DDU during Limited Integration Mode);

iv. LonWorks Communications Port (for connection to the VLU during Full Integration Mode).

6.III-4.3 Performance Requirements - OBFTP

The following performance requirements supplement those stated in Section 6.III-3.3.

(a) The placement of the OBFTP shall promote an accelerated throughput of passengers.

(b) The minimum throughput rate for OBFTP shall be 30 passengers per minute.

(c) The throughput rates assume passengers familiar with system operation with a valid fare card, no mis-reads or cards with insufficient value, and no automatic revalue.

(d) The Contractor shall conduct a human factors analysis with regard to the placement of the OBFTP and confirm the results of the analysis through the human factors test in accordance with Section 6.II-11.4.1.

6.III-4.4 Physical Requirements - OBFTP

The following physical requirements supplement those stated in Section 6.III-3.4.

4.4.1 Dimensions and Layout

A prototype of each OBFTP configuration and its mounting shall be demonstrated at time of PDR on each Agency bus type mounting location. Access to the vehicles will be coordinated through the Project Manager.

4.4.2 Structural Features

(a) All on-board equipment provided under this contract shall resist shocks equal to 5.0g without permanent deformation or failure of mounts or diminution of operational characteristics of any subsystems.

(b) The OBFTP enclosure shall be stainless steel or approved alternative subject to the approval of the Project Manager.

6.III-4.5 Electrical Requirements - OBFTP

Equipment installed on-board transit vehicles shall meet the following power supply requirements:

(a) Nominal voltage: 12 to 24 volts DC nominal (car or bus battery)

(b) Operating range: 9 to 39 volts DC

(c) Equipment shall be able to withstand sustained voltage levels of up to 48 VDC for up to ten (10) minutes.

(d) Equipment shall not suffer damage or lose data in memory when the supply is increased to 48 VDC.

(e) Equipment shall not suffer corruption of data when the power dips below 9 VDC.

(f) Equipment shall not be damaged by very high (twenty [20] times nominal voltage) short duration (up to ten [10] milliseconds) peak voltage.

(g) Contractor shall indicate full operational and quiescent power drain for each on-board module proposed.

6.III-4.6 Data Exchange Requirements - OBFTP

The following data exchange requirements supplement those stated in Section 6.III-3.6.

(a) To the greatest extent possible, data communications between the OBFTP and other on-board devices shall comply with the applicable Transit Communications Interface Profiles (TCIP) standards that are in effect at the time of Notice to Proceed.

(b) Communications between the OBFTP and DDU shall be via J1708.

(c) Communications between the FTP and future VLU shall be via LonWorks.

(d) The Contractor shall provide the drivers and the interface software for the OBFTP and shall provide the necessary support for developing the interface software with, for example, the farebox manufacturer, AVL supplier, or smart bus contractor.

(e) The OBFTP shall have the capabilities to allow configuration changes and system maintenance activities to occur through the use of a laptop computer. Any configuration changes and/or system maintenance activities conducted shall be accounted for in the FTP memory and a record shall be transferred to the clearinghouse during the next fare card transaction data transfer.

(f) The OBFTP shall be also equipped with a LonWorks port that transmits a duplicate record of the transaction as it occurs which may be captured by other non-RFCS related equipment, such as the VLU, when installed under the full integration mode. The communications protocol and data record format are subject to Project Manager approval.

4.6.1 Electronic Registering Fareboxes

4.6.1.1 GFI Farebox Keypad Emulation

For the Limited Integration Mode, the Contractor shall emulate the functions of the GFI Electronic Registering Farebox keypad and display units, using the keypad and display of the DDU.

(a) A record of each farebox transaction shall be entered, upon operator input, via the DDU and stored in the OBFTP in time-linear sequence with FTP transactions.

(b) The OBFTP transaction record template shall contain sufficient fields to accommodate farebox transactions and flag the transaction as originating from the farebox.

(c) Flagged farebox transactions shall be formatted to allow the farebox transaction data to be parsed from the database, after WDOLS upload to the DACS, for separate processing.

4.6.1.2 GFI Farebox Dump Signal

The Contractor shall provide a mechanism, to be approved by the affected agency, for actuating the farebox dump key after each farebox transaction by one of the following means:

(a) Provide a device that can accept a Farebox Transaction Complete signal from the FTP, via the LonWorks port, and convert that signal to an electrical impulse that forces the dump cycle of the farebox, via hardwired, discrete electrical connection.

(b) Provide a Farebox Transaction Complete switch closure at a connector on the FTP that can be used to momentarily short the farebox dump key, via hardwired, discrete electrical connection.

Not all agencies may elect to choose this function for their particular configuration.

4.6.2 Global Positioning System (Option)

The OBFTP shall be able to accommodate integration with a commercially available Global Positioning System (GPS) device for providing the coordinates of each transaction location.

If the Contractor proposes to provide GPS, the following requirements will apply:

(a) The GPS device shall be LonWorks-compatible and provide its signal to other devices on the LonWorks network

(b) The contractor shall explain how a Differential GPS correction signal will be provided to the on-board system

(c) The GPS device shall be a separate, modular unit approved by the Association.

6.III-4.7 Installation Requirements - OBFTP

The Contractor shall work with each Agency's Review Group to determine on-board equipment location and installation restrictions. Any RFCS equipment mounted in a vehicle is subject to review and approval of the relevant Agency.

(a) All mounting hardware associated with the OBFTPs shall be provided by the Contractor.

(b) The mounting hardware and the OBFTP shall be positioned such that it minimizes encroachment on the passenger and the driver, and does not obstruct the driver's right mirror field of vision and view to the right front of the bus including the view of the front door.

(c) The OBFTP mounting location shall allow ease of driver entry and exit from the driver's compartment with no risk of injury such as knees.

(d) The Contractor shall provide a flexible mounting system that allows the mounting location to be optimized, maximizing passenger throughput and driver operability and comfort.

6.III-5 VEHICLE LOGIC UNIT (VLU) - *[PROVIDED BY OTHERS]*

The information about the VLU in this Section is provided for information purposes only.

6.III-5.1 Subsystem Description – VLU

The VLU will be installed by others for the purpose of evolving to a fully integrated on-board system. This is referred to as the Full Integration Mode (FIM). When installed, the VLU will function as the on-board server or central processor. The VLU will receive a duplicate record each time a fare transaction occurs, store each record in the same format as the OBFTP, verify the accuracy of each record, and download the fare data through the WDOLS. The VLU will also support multiple, concurrent applications such as vehicle location, passenger counting, vehicle operating data, stop annunciation and other functions, and will store and buffer data from these systems for off-load by the WDOLS.

As part of the transition from Limited Integration Mode (LIM) to FIM,

- the WDOLS connection will be moved from the OBFTP to the VLU, and data exchange with the DAC will occur through the VLU; and
- the connection to the DDU will be moved to the VLU, and the operator interface with the OBFTP will occur through the VLU.

It is envisioned that the VLU and OBFTP will maintain exactly the same fare transaction data file, which will be verified upon data exchange, until cleared with instructions from the DAC. The DAC will segregate the data and forward all Smart Card transaction data to the clearinghouse.

6.III-6 DRIVER DISPLAY UNIT (DDU)

6.III-6.1 Subsystem Description - DDU

The DDU shall display OBFTP information and provide the human interface for interacting with on-board systems. The DDU shall consist of a display, and a keyboard. The display and the keyboard shall be combined through the use of an on-board flat panel touch-screen display, or a display with soft keys on the perimeter.

In keeping with the Association's open, modular system architecture, the DDU shall be packaged separately and not bundled with the FTP or WDOLS. The DDU shall be a QSI Corporation model K60V (the "V" indicates vertically oriented aspect ratio) or Association approved equivalent.

6.III-6.2 Functional Requirements – DDU

6.2.1 Keyboard

The keyboard shall provide the human interface with the OBFTP, the Radio Control Unit (King County requirement) and any future subsystems installed on the J1708 network, such as the VLU.

(a) There shall be two methods of performing driver sign-on and sign-off, selectable through software at Agency option.

i. The driver shall be able to perform this function through a keypad.

ii. The driver shall be able to tag the card reader with a smart card to perform this function.

(b) The driver shall be able to enter fare set/category, fall-back voice radio channel, operator identification, run, route or time segmentation data on the driver keypad, either as a primary data entry or as a backup to any vehicle location system which may be installed to support this function.

(c) Data for settlement shall be collected even with driver log-on errors.

(d) The system shall be able to collect transaction data in the event incorrect log-on data is entered by the driver, or when no log-on is entered at all, the driver shall be alerted through an audible alarm, and a flashing message on the driver display.

(e) The keypad/board shall be used by driver to flag a transaction record in the event of a transaction that consists of a pass and a stored value fare upgrade, or to override logic in order to handle

exception conditions such as multiple boardings using a single card.

(f) The keypad/board shall be configurable to emulate the electronic registering fare box keypad and replace the manual counters used with non-registering fare boxes. [include “dump” feature here?]

(g) Provide a minimum of twelve soft keys.

6.2.2 Display

The display shall allow monitoring of the OBFTP and any subsystems connected to the VLU.

(a) The display shall allow monitoring of the OBFTP status and mirror the customer display during each transaction.

(b) The display shall serve as the monitor for interfacing with the FTP, RCU and the future VLU for system maintenance and configuration changes.

(c) The Agencies will define the message sets and formats with the Contractor during the design review process (CDRL 8).

6.III-6.3 Performance Requirements - DDU

The DDU technology shall be subject to Project Manager approval and shall meet the following requirements:

(a) Readable in all lighting conditions encountered on a bus during day and night, such as direct sunlight or driving in rural areas with limited outdoor lighting.

(b) All keys or buttons shall have a minimum life of 10 million actuations.

6.III-6.4 Physical Requirements – DDU

The DDU shall meet the physical requirements in Section 6.III-4.4 and the following:

(a) The DDU shall be designed to be water and liquid resistant, and the enclosure shall be water and liquid tight.

(b) Any leakage into the unit shall not cause the unit to become non-operational.

(c) The DDU shall resist breakage due to accidental impacts from hard objects, such as briefcases during boarding, or wheelchair handles or other devices used by the disabled community.

(d) DDU shall be a lighted LCD graphics display with a minimum 128x240 pixels.

(e) The keypad/board shall be designed to be water and liquid resistant, and the enclosure shall be water and liquid tight.

(f) The maximum size of the DDU shall be 5-1/2 inches wide by 8-1/2 inches high by 4-1/2 inches deep.

6.III-6.5 Electrical Requirements – DDU

The electrical requirements specified in Section 6.III-4.5 shall apply to the DDU.

6.III-6.6 Data Exchange Requirements – DDU

The DDU shall be designed to accommodate the use of the SAE J1708 standard as the communications network for integrating to the OBFTP, the Radio Control Unit (RCU) and future VLU, when available. (DR 26)

6.III-6.7 Installation Requirements - DDU

The DDU shall be installed in accordance with the requirements specified in Section 6.III-4.7 as they apply to a DDU.

6.III-6.8 Integration Requirements - DDU

The driver display unit shall have the capabilities to replace the existing MDT as the universal display/keypad device for King County Metro and shall be adaptable by all agencies to accommodate integration with their future on-board systems.

(a) The Contractor shall develop the necessary software to support the on-board operations of the RFCS. The Contractor's software shall be integrated with software developed by others that supports existing systems, such as King County Metro's radio/AVL system. Interface requirements for the King County RCU will be provided to the Contractor.

(b) The DDU shall be supplied with software tools to allow modification by the Association, so that each agency can modify operator functionality to accommodate future on-board systems.

6.III-7 WIRELESS DATA ON/OFF LOADING SYSTEM (WDOLS)

6.III-7.1 Subsystem Description

The Contractor shall provide a commercially available, off-the-shelf Wireless Data On/Off Loading System (WDOLS) as the primary method for transferring data to-and-from the OBFTP or the VLU to the designated DACS. It is intended that the WDOLS shall be used to transmit data from other sources in addition to the FTP. Also, the WDOLS may be used to transfer data from FTPs in remote locations where installing a hard wire communications link is the less cost effective solution, e.g., stand-alone FTPs located on docks in the WSF environment or platforms in the Sound Transit environment. The proposed technology shall be subject to the review and approval of the Project Manager (CDRL 39).

6.III-7.2 Functional Requirements

(a) The WDOLS shall automatically initiate the data exchange when the bus enters the range of operation, and shall save the data on the designated DACS without manual intervention.

(b) WDOLS equipment at transit bases or other fixed locations shall be able to communicate with all WDOLS equipped buses, regardless of agency.

(c) Vehicles shall not be required to stop during the data exchange.

i. The Contractor shall indicate the maximum vehicle speed to permit successful data exchange.

ii. The vehicle speed limit shall be subject to Project Manager approval prior to implementation.

(a) At a minimum, the WDOLS shall be used for the following:

i. Uploading of transaction data captured at the FTP

ii. Downloading of files such as:

- Software configuration files
- FTP initialization
- Fare tables
- Blocked card list
- Automatic revalue list, if used
- Other operational parameter tables

6.III-7.3 Performance Requirements - WDOLS

The data transmission speed shall be sufficient to on- and off-load on-board transaction data from the entire fleet or designated remotely located FTPs, at a minimum on a daily basis.

(a) The WDOLS's data transfer process shall be transparent to current operations and shall not require operational modifications.

(b) The WDOLS shall be able to operate at a range of at least 1000 feet between the vehicles and external antenna units.

(c) The data exchange rate shall be a minimum of 1megabit per second.

(d) The data exchange shall not be affected by other RF sources or transmissions.

(e) The WDOLS shall conform to the IEEE 802.11 communications standard or an Association approved equivalent.

6.III-7.4 Physical Requirements – WDOLS

(a) In keeping with the Association's modular, open architecture, the WDOLS shall be packaged separately, and not bundled with the FTP or DDU.

(b) The enclosure materials shall be high strength polycarbonate, cast aluminum, stainless steel or equivalent subject to the review and approval of the Project Manager.

(c) Enclosure shall be vandal resistant, flame retardant and resistant to common solvents and cleaning materials.

(d) The WDOLS shall be sealed to prevent any degradation in operation due to the accumulation of dust, salt, mud, detergents, solvents, or moisture.

(e) Any outdoor mounted equipment shall be rated for operation in an exposed environment.

6.III-7.5 Electrical Requirements – WDOLS

7.5.1 Vehicle Mounted Equipment

The electrical requirements specified in Section 6.III-4.5 shall apply to all vehicle mounted WDOLS equipment.

7.5.2 Base or Terminal Mounted Equipment

The electrical requirements specified in Section 6.III-1.6 shall apply to all base or terminal mounted WDOLS equipment.

6.III-7.6 Data Exchange Requirements – WDOLS

(a) The Contractor shall provide a high-speed serial communications device that meets the performance requirements in 6.III-7.3. In the initial, limited integration mode, the WDOLS shall be connected directly to the FTP. In the future, full integration mode, the WDOLS shall be disconnected from the FTP and connected to the VLU.

(b) The WDOLS shall include data integrity features such as, but not limited to, a check to ensure that the data to be downloaded to the FTP has been captured by the FTP and a check to ensure that no duplicate downloads or uploads of data occur.

(c) In the event of a failed data exchange attempt, the system shall sound an alarm at the FTP display and the DAC, and log the event in the FTP and the DAC.

(d) Immediately following the failed data exchange event, the DAC shall notify the clearinghouse of the event.

(e) The WDOLS shall also provide anti-collision such that multiple vehicles can be parked in the same area without loss or corruption of data.

(f) The WDOLS shall be capable of handling data from multiple on-board sources, such as the APC system, AVL system, electronic farebox, and various engine/vehicle monitoring systems.

(g) The Base WDOLS shall be capable of sorting multiple data types into appropriately labeled files that can be managed with standard data management software.

(h) The contractor shall propose troubleshooting tools that allow agency staff to identify and fix data exchange problems occurring in the WDOLS.

(i) The Contractor shall provide a method, subject to Association approval, of managing the data exchange to ensure that the appropriate data is exchanged at the appropriate location and time.

6.III-7.7 Installation Requirements - WDOLS

7.7.1 Vehicle Mounted Equipment

(a) Any WDOLS related equipment on-board any vehicle shall meet the requirements in Section 6.III-4.7.

(b) The antenna location(s) for each agency shall be subject to approval by the respective agencies.

(c) Any exterior mounted equipment shall be sealed to prevent leakage of rain or bus washer fluids through the life of the installation.

7.7.2 Operating Base Mounted Equipment

(a) The antenna shall be mounted in or near a location approved by the Project Manager.

(b) The Contractor shall finalize the locations of any externally mounted antennas with the Project Manager during the design review process (DR 42).

(c) The Contractor shall mount all WDOLS related equipment and shall make all power and communications connections.